Attachment 1

40 CFR 63 Subpart NNNNN
National Emission Standards for Hazardous Air Pollutants
Emissions from Hydrochloric Acid Production
Compliance Test Report
954 HCl Production Facility
Renewable Operating Permit (ROP) 4033
Water Scrubber T-101 (EU85-S1)

The Dow Chemical Company
Michigan Operations
Midland, Michigan

Sampling Date: November 18, 2016

**** Please note the process unit is the final copy holder and owner of this document. A temporary electronic copy will be retained by internal stack testing group for a short period of time.***

1.0 INTRODUCTION

Summary of Test Program

The Dow Chemical Company (Dow) is submitting this test report supporting performance testing to be conducted in order to demonstrate compliance with the 40 CFR Part 63, Subpart NNNNN (HCl MACT) for the exhaust of the FFAB Scrubber (SVFFAB-EU85) at the 954 Building in Midland, Michigan.

Responsible Groups	• The Dow Chemical Company • Michigan Department of Environmental Quality (MDEQ) • Environmental Protection Agency
Applicable Regulations	• 40 CFR 63 Subpart NNNNN
Industry / Plant	• HCl Production
Plant Location	• The Dow Chemical Company Midland, Michigan
Date of Last Compliance Test	• November 29, 2011
Air Pollution Control Equipment	• T-101 FFAB Scrubber
Emission Points	• T-101 FFAB Scrubber (SVFFAB-EU85)
Pollutants Measured	• Hydrogen Chloride (HCl) • Chlorine (Cl2)
Test Date	• November 18, 2016

Key Personnel

- Megan Feil provided support as the Process Focal Point. The Process Focal Point is responsible for coordinating the plant operation during the test and ensuring the unit is operating at the agreed upon conditions in the test plan. The Process Focal Point also serves as the key contact for collecting any process data required and providing all technical support related to process operation.
- Brad Kischnick provided support as an Environmental Focal Point. The Environmental Focal Point is responsible for ensuring that all regulatory requirements and citations have been reviewed and considered for the testing.
- Kayla Peacock also provide support as an Environmental Focal Point. All agency communication will be completed through her role. Her contact information is:

  Kayla Peacock
  The Dow Chemical Company – Michigan Operations
  1100 Building
  Midland, MI 48667
  Phone: (989) 638-1482
  Email: KMPeacock@dow.com
- Chuck Glenn works for the Dow Chemical stack testing team. He served as the test plan coordinator and is responsible for the overall leadership of the sampling program. He developed the overall testing plan, determine the correct sample methods and complete the final report. His contact information is:

  Chuck Glenn
  The Dow Chemical Company – Texas Operations
  B2301 Brazosport Blvd B-2009
  Freeport, TX 77541
  Phone: (979) 238-9109
  Email: CEGlenn@dow.com
- Spencer Hurley works for The Dow Chemical Company EH&S Delivery group. He served as the technical review role of the test data and back-up for Mr. Glenn.
- Dan Bennett works for AECOM Technology Corporation and provided support the as Sample Team Leader for the internal Dow Air Sample Team. The Sample Team Leader is responsible for ensuring that the data generated met the quality assurance objectives of the plan.
- Michael Abel is a PhD chemist who also served technical contact for air sampling. Michael serves as a quality assurance and technical reviewer of the final test plan/report.

2.0 PLANT AND SAMPLING LOCATION DESCRIPTION

Process Description

There is an anhydrous hydrogen chloride (HCl) distribution process and aqueous HCl production (32% - 36%) and distribution process at 954 Building.

Anhydrous HCl is received in rail cars or tube trailers as a liquid. The liquid anhydrous HCl from railcars is unloaded into two storage tanks. The anhydrous HCl from the tube trailer has the potential to vent either to the 954 THROX Absorber and 954 THROX Scrubber or the HCl FFAB Absorber and FFAB Scrubber. The HCl FFAB Absorber is not considered air pollution control equipment.

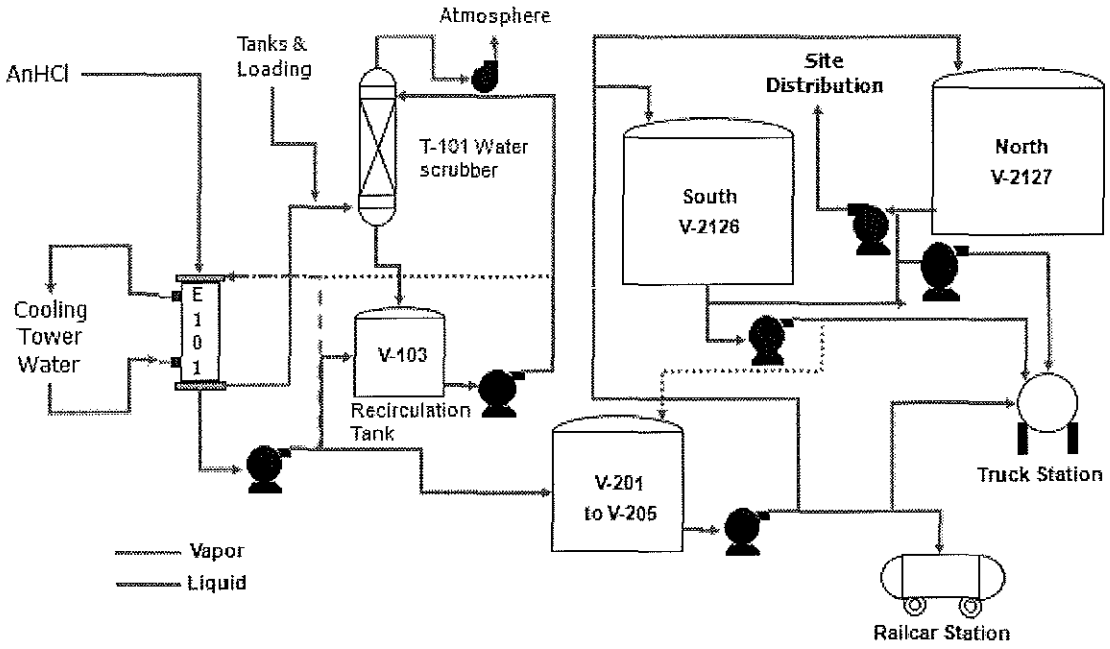
From the storage tanks and/or tube trailer, the liquid anhydrous HCl is vaporized and distributed to the plant via pipeline. Anhydrous HCl can also be sent to the FFAB Absorber to manufacture aqueous HCl for plant use or outside sales. Aqueous HCl can also be brought in via railcar and tank truck. The aqueous HCl is stored in two 40x40 storage tanks (V-2126 & V-2127) and five 25,000 gallon storage tanks (V-201, V-202, V-203, V-204, and V-205).

Aqueous HCl is loaded into rail cars and trucks from tank nos. V-2126 & V-2127, or V-201, V-202, V-203, V-204 & V-205. Vents on the FFAB Absorber, all aqueous HCl storage tanks, rail cars, and tank trucks are connected to the FFAB Scrubber prior to venting to the atmosphere. The HAT Venturi Scrubber is used as a back-up if the FFAB Scrubber is down.

Control Equipment Description

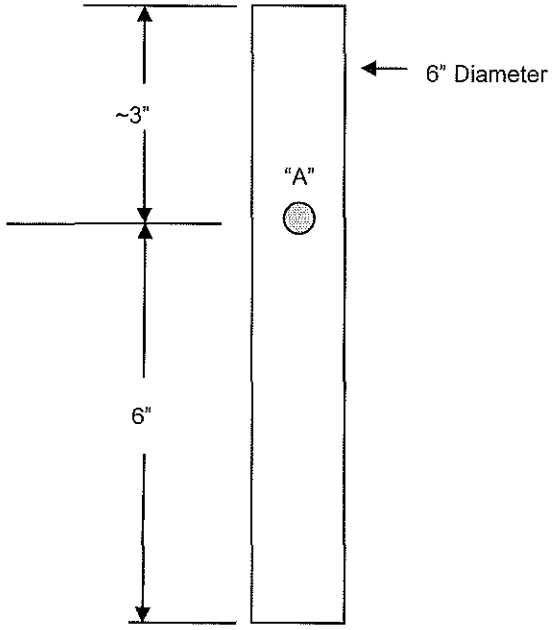
FFAB Scrubber System:

The FFAB water scrubber (T-101) is located after the FFAB Absorber (E-101). The design vapor flow rate of the scrubber is 470 SCFM and the absorbing media used is recirculated water (less than 6% HCl). This scrubber receives process exhaust from the aqueous HCl production and distribution system, all storage tanks, rail cars and tank truck loading and unloading facilities, and the anhydrous HCl distribution systems. This scrubber vents to Vent No. SVFFAB-01.



Flue Gas Sampling Locations

The T-101 scrubber has one sample port installed that meet the minimum requirements of EPA Method 1 to be utilized for sampling. The outlet has a 3" port in the 6" stack was utilized for the flow and HCl sample collection.



3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

Objectives

The purpose of this test is to demonstrate compliance with the requirements of 40 CFR Part 63, the HCl MACT (Subpart NNNNN). The specific objective is:

- Measure the HCl emissions from the T-101 scrubber stack to demonstrate the scrubber system exhaust from existing HCl process vents, storage tanks and transfer operations is $\leq$ 20 ppmv HCl and $\leq$ 100 ppmv Cl2 or reduce HCl and Cl2 (HCl process vent requirement only) emissions by $\geq$ 99 percent
- Scrubber pH does not need to be monitored during this performance test per EPA approval letter dated October 27, 2005 (submitted with test plan)
- Record and establish the minimum scrubber inlet water flow rate during testing.

Facility Operation

The FFAB water scrubber (T-101) is located after the FFAB Absorber (E-101). The design vapor flow rate of the scrubber is 470 SCFM and the absorbing media used is recirculated water (less than 6% HCl). This scrubber receives process exhaust from the aqueous HCl production and distribution system, all storage tanks, rail cars and tank truck loading and unloading facilities, and the anhydrous HCl distribution systems. This scrubber vents to Vent No. SVFFAB-01.

Results

The scrubber was within the allowable limits for all species analyzed.

Comments/Exceptions

- Kathy Brewer of the Michigan Department of Environmental Quality observed testing.
- As required, a Hydrogen Halides evaluation sample was submitted and found acceptable. The evaluation standard was provided by ERA. A final report provided by ERA can be found in the Analytical section of this report.
- Dow obtained MDEQ approval to conduct testing without receiving the AnHCl vent stream from 948 Building as their process has been permanently shutdown.

Emission Results

Sample Type	Test Method	Sampling Time (Min/Run)	Allowable Emission Rate	Actual Emission Rate*
HCl Conc	EPA Method 26	60	<20 ppmv	< 0.1 ppmv
Cl2 Conc	EPA Method 26	60	<100 ppmv	< 0.1 ppmv

* Emissions based on average of three one-hour runs.

Testing Run Data

PARAMETER	RUN 1	RUN 2	RUN 3	AVERAGE
Run Date	11/18/2016	11/18/2016	11/18/2016	N/A
Run Times	1024/1124	1137/1237	1254/1354	N/A
Catch Wt. HCl in Outlet (ug)	< 5.14	< 5.66	< 5.45	< 5.42
Conc. HCl (ppmv)	**< 0.09**	**< 0.10**	**< 0.09**	**< 0.09**
Catch Wt. Cl2 in Outlet (ug)	< 5.00	< 5.50	< 5.70	< 5.23
Conc. Cl2 (ppmv)	**< 0.04**	**< 0.05**	**< 0.05**	**< 0.05**

Operational Rates

PARAMETER	RUN 1	RUN 2	RUN 3	AVERAGE
Run Date	11/18/2016	11/18/2016	11/18/2016	N/A
Run Times	1024/1124	1137/1237	1254/1354	N/A
Anhydrous HCl flow from 954 to E-101 (lb/hr)	139.0	138.4	141.7	139.7
Aqueous HCl flow to HAT Tanks (GPM)	6.69	7.10	6.17	6.65
Inlet water flow to T-101 (GPM)	11.95	12.11	12.05	12.04
T-101 Recirculation flow (GPM)	12.14	5.98	5.95	8.02
V-103 % HCl Density (%)	-0.09	-0.09	-0.10	-0.09
AqHCl Railcar Spot 4 HCl flow (GPM)	-85.69	-85.12	-83.03	-84.61

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Test Methods

Please note Dow was given permission *(submitted with test plan)* ***to determine HCl/Cl_2 concentration utilizing EPA Method 26 as previously allowed in other test events.*** The sample point to be used is known to be "dry" and yielded an accurate concentration. The average velocity is approximately 7 ft/s and the average flow rate is approximately 4,600 dry standard cubic feet. The gas composition is approximately 21% oxygen with the trace HCl and the balance nitrogen.

HCl/Cl2 Sampling - EPA Method 26

The EPA Method 26 sampling train was used to determine HCl and Cl_2 emissions. The average sampling rate for each run was approximately 2 liters/minute. Each test run was one hour in duration. To avoid possible contamination, heated Teflon tubing was used for sample collection. The sampling train is described as follows:

- The first and second impinger consisted of 0.1N H2SO4
- The third and fourth impinger was 0.1N NaOH
- A fifth impinger was filled with silica gel to prevent water from getting to the dry gas meter.
- The two impingers containing sulfuric acid were analyzed for HCl by Ion Chromatography (EPA Method 26).
- The remaining two caustic impingers were analyzed for Chlorine by Ion Chromatography (EPA method 26) after the addition of sodium thiosulfate to react any hypochlorous acid to chloride.

5.0 CALCULATIONS

Stack Gas Emission Rate Calculations

HCl Concentration

The hydrochloric acid concentration rate is calculated according to the following equation:

$$\mathrm{HCl_{Conc}} = \frac{(\mathrm{CW_{HCl}})/(\mathrm{MW_{HCl}})}{(\mathrm{Vm})/(24.056\ \mathrm{L/mol})}$$

where: $HCl_{Conc} = Concentration\ of\ Hydrochloric\ Acid\ (ppmv)$
$CW_{HCl} = Concentration\ of\ Hydrochloric\ Acid\ in\ Knockout\ (ug)$
$MW_{HCl} = Molecular\ weight\ of\ HCl\ (g/mol)$
$Vm = Volume\ of\ sample\ collected\ (Liters)$

Emission Rate Example Run#1

$$\mathrm{HCl_{Conc}} = \frac{(< 5.14\ \mu g)/(36.46\ \mathrm{g/mol})}{(38.617\ \mathrm{L})/(24.056\ \mathrm{L/mol})} = \underline{< 0.1\ ppmv}$$

Cl_2 Concentration

The chlorine concentration rate is calculated according to the following equation:

$$\mathrm{Cl2_{Conc}} = \frac{(\mathrm{CW_{Cl2}})/(\mathrm{MW_{Cl2}})}{(\mathrm{Vm})/(24.056\ \mathrm{L/mol})}$$

where: $Cl2_{Conc} = Concentration\ of\ Chlorine\ (ppmv)$
$CW_{Cl2} = Concentration\ of\ Chlorine\ in\ Knockout\ (ug)$
$MW_{Cl2} = Molecular\ weight\ of\ Cl2\ (g/mol)$
$Vm = Volume\ of\ sample\ collected\ (Liters)$

Emission Rate Example Run#1

$$\mathrm{Cl2_{Conc}} = \frac{(< 5.00\ \mu g)/(70.91\ \mathrm{g/mol})}{(38.617\ \mathrm{L})/(24.056\ \mathrm{L/mol})} = \underline{< 0.1\ ppmv}$$